intervals of an hour. Barometer and thermometer readings were taken hourly throughout the night. Six circumpolars, at least, three at upper culmination and three at lower, were always observed upon a long night, and three nadir, level and collimation determinations were made. Readings were also made upon the south collimator at the beginning and end of the work, to serve as a check upon the azimuth in case the last pair of circumpolars should be lost by clouds.

The routine from beginning to end of the night—twilight to twilight—was practically uninterrupted; the chronograph was never suffered to run down, and I could easily substitute a new sheet while the cylinder was making one-third of a revolution. Usually, however, two sheets, corresponding to four hours' work, were fastened upon the barrel at a time, and it was then the work of a few seconds only to strip off the upper one. During the day, the transits—more than 4000—upon the chronograph sheets were read off, the stars were identified and the observations were recorded, and a new programme was arranged for the coming night. The basis of the programme was our Zone Catalogue, of course, but all the anonymous stars of which the observer gave any note during the observations were also incorporated.

The above was the rigorous procedure during the month of December, not omitting readings for runs and any other desirable operation that could be performed in daylight. During all this time there was neither strain, nor hurry, nor fret over a failure, but every operation was in the charge of an assistant who knew how to do it well in the least possible time. The longest nights were those of December 23, 24, 25 and 26—32 hours in all—aggregating 1549 complete determinations. The gentlemen who assisted me were Messrs. BACHMANN, DAVIS and STEVENS, but in the circle room there was no distinction of person and we alternated according to rule. I had employed the same method during the four preceding months, also, but in less degree, and by way of practice."

ARGENTINE NATIONAL ORSERVATORY,
CORDOBA, June 24, 1891.

GIFT TO THE LICK OBSERVATORY FROM PROF. MICHELSON.

In Vol. III of the *Publications* (page 274) Prof. MICHELSON describes an apparatus devised by himself for making measures of very small angles by interference methods and gives observations

of the diameters of *Jupiter's* satellites made by himself during the summer of 1891 with such an apparatus applied to our 12-inch equatorial.

Since that time Prof. MICHELSON has had a similar device constructed by WARNER & SWASEY to fit the 36-inch telescope, with which it is hoped to measure the diameters of some of the smaller satellites, and of some of the asteroids. The apparatus is now completed and has been presented to the observatory through the kindness of Prof. MICHELSON. E. S. H.

December 25, 1891.

HANDBOOK OF PRACTICAL OPTICS BY STEINHEIL & VOIT.

[*Handbuch der Angewandten Optik* von Dr. A. STEINHEIL und Dr. E. VOIT, Band I, pp. 314 (Leipzig, 1891.)].

Messrs. STEINHEIL & VOIT need hardly have remarked in the preface to their recently published *Handbuch* that the work was the outcome of thirty years' experience in grinding lenses. For whether the reader approve their methods or not, he must see that these bear the stamp of practicability. We have before us a product of this well-known Munich *atelier*, which gives ample evidence that if lens grinding be an art, it is also *more* than an art.

The interested readers will be rather the users than the makers of telescopes; for, though the work is professedly written for the latter class, it contains general methods, illustrated by many special cases, for computing, with great accuracy, the efficiency of a lens either as regards its correction for color or spherical aberration, its definition, distortion, fulfillment of Gaussian condition, flatness of field, etc. What strikes one most in this treatment is perhaps the rigidity of the methods employed. There is a refreshing absence of approximations; focal lengths are never measured save from principal points; thicknesses of lenses are never disregarded; the air-space of separation in double objectives receives its full share of attention.

A rigid adherence to a clear and simple notation adds immensely to the lucidity of the discussion. To feel the importance of this, one has only to recall that in a corrected glass there are three media each with its own refractive index and thickness, besides four refracting surfaces each with its own radius, its own angles of incidence and refraction. The notation adopted is that of SEIDEL in which the successive *surfaces* and quantities asso-